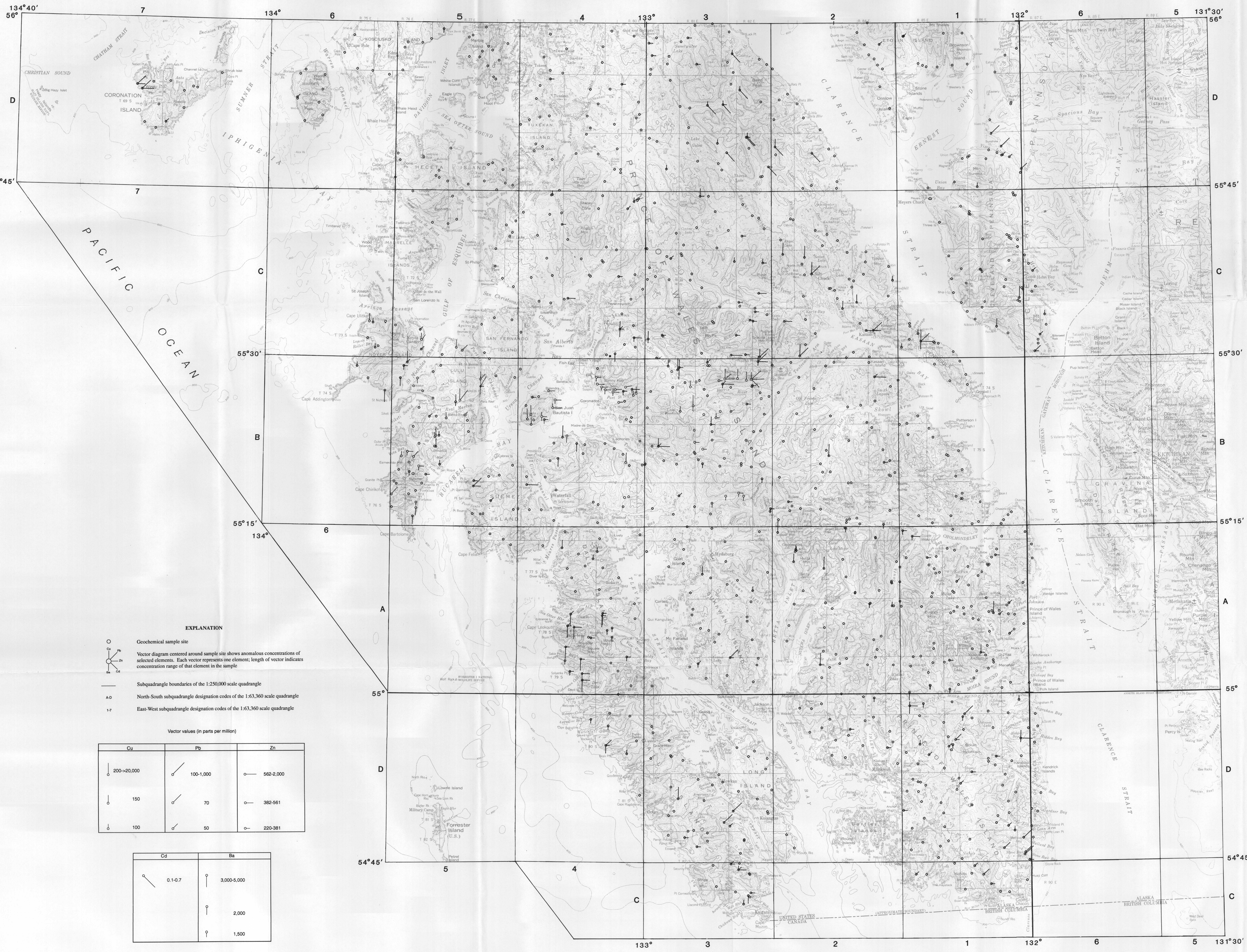
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-2217-A
SHEET 1 OF 2



EXPLANATION

○	Geochemical sample site
Cu, Pb, Zn, Cd, Ba	Vector diagram centered around sample site shows anomalous concentrations of selected elements. Each vector represents one element; length of vector indicates concentration range of that element in the sample
——	Subquadrangle boundaries of the 1:250,000 scale quadrangle
A-D	North-South subquadrangle designation codes of the 1:63,360 scale quadrangle
1-7	East-West subquadrangle designation codes of the 1:63,360 scale quadrangle

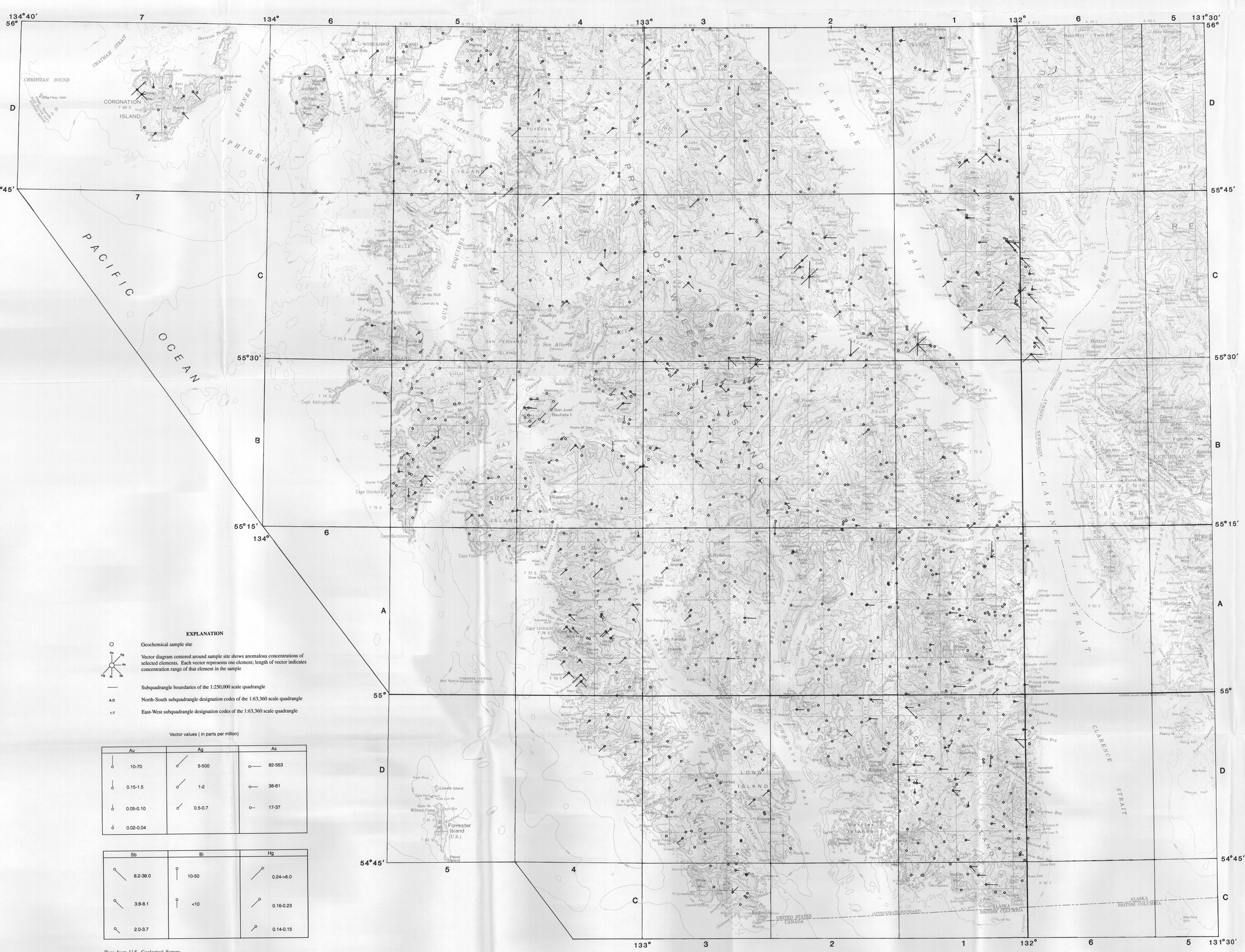
Vector values (in parts per million)

Cu	Pb	Zn
200->20,000	100-1,000	562-2,000
150	70	382-561
100	50	220-381

Cd	Ba
0.1-0.7	3,000-5,000
	2,000
	1,500

SCALE 1:250 000
5 0 5 10 15 20 25 MILES
5 0 5 10 15 20 25 KILOMETERS
CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP A. DISTRIBUTION AND ABUNDANCE OF Cu, Pb, Zn, Cd, AND Ba



EXPLANATION

○	Geochemical sample site
Au, Ag, As, Sb, Bi, Hg	Vector diagram centered around sample site shows anomalous concentrations of selected elements. Each vector represents one element; length of vector indicates concentration range of that element in the sample
——	Subquadrangle boundaries of the 1:250,000 scale quadrangle
A-D	North-South subquadrangle designation codes of the 1:63,360 scale quadrangle
1-7	East-West subquadrangle designation codes of the 1:63,360 scale quadrangle

Vector values (in parts per million)

Au	Ag	As
10-70	5-500	82-563
0.15-1.5	1-2	38-81
0.05-0.10	0.5-0.7	17-37
0.02-0.04		

Sb	Bi	Hg
8.2-38.0	10-50	0.24->6.0
3.8-8.1	<10	0.16-0.23
2.0-3.7		0.14-0.15

Base from U.S. Geological Survey
Craig, 1957; Dixon Entrance, 1959; Ketchikan, 1955; Prince Rupert, 1959
Universal Transverse Mercator projection. 1927 North American datum

SCALE 1:250 000
5 0 5 10 15 20 25 MILES
5 0 5 10 15 20 25 KILOMETERS
CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP B. DISTRIBUTION AND ABUNDANCE OF Au, Ag, As, Sb, Bi, AND Hg

INTRODUCTION

The U.S. Geological Survey (USGS) is required by the Alaska National Interest Lands Conservation Act (ANILCA, Public Law 96-487) to survey certain Federal lands to determine their mineral resource potential. Results from the Alaska Mineral Resource Appraisal Program (AMRAP) must be made available to the public and be submitted to the President and Congress. This report presents the distributions of anomalous concentrations of 17 elements in minus-80-mesh stream-sediment samples collected in 1969, 1983-1985, and 1989 from the Craig study area. The study area includes all of the Craig, Dixon Entrance, and a small part of the western edges of the Ketchikan and Prince Rupert quadrangles (1:250,000). The Craig study area is located in southeastern Alaska and includes (from west to east) parts of the Prince of Wales Mountains, Kupreanof Lowlands, and Coastal Foothills physiographic divisions of Wahrhaftig (1965).

GEOLOGY

The Craig study area contains parts of three northwest-trending tectonostratigraphic terranes (Berg and others, 1972, 1978; Monger and Berg, 1987). From the southwest to the northeast, they are the Alexander terrane, the Gravina-Nutzotin overlap assemblage, and the controversial Taku terrane (Brew and Ford, 1984).

The Alexander terrane consists of Paleozoic sedimentary and volcanic rocks, as well as Paleozoic and Mesozoic intrusive rocks in the region of Prince of Wales Island and Dall Island southwest of Clarence Strait, and the southernmost part of the Cleveland Peninsula on the northeast side of Clarence Strait. The rocks of the terrane range in age from Proterozoic(?) to Pennsylvanian. Unmetamorphosed rocks of Ordovician and younger age appear to stratigraphically overlay generally low-grade metamorphic rocks of the Wales Group (Eberlein and Churkin, 1970). The Wales Group is a structurally complex assemblage of predominantly andesitic to basaltic marine fragmental volcanic rocks and flows interbedded with graywacke, mudstone, shale, and local marble. The Wales Group is regionally deformed and metamorphosed to greenschist and, in places, amphibolite facies. The southern part of the Alexander terrane includes an Ordovician to Silurian volcanoplutonic complex of diorite, trondhjemite, and cogenetic volcanic and volcaniclastic rocks that are in fault contact with the Wales Group (Eberlein and others, 1983; Gehrels and others, 1983a, b).

Most of the rocks northeast of Clarence Strait have been assigned to the Gravina-Nutzotin overlap assemblage and Taku terrane (Berg and others, 1978; Monger and Berg, 1987; Brew and Ford, 1984). The Gravina-Nutzotin overlap assemblage underlies part of the south end of the Cleveland Peninsula, southern Etolin Island, and Onslow Island. The overlap assemblage consists of marine flysch, argillite, graywacke, and interbedded andesitic to basaltic volcanic and volcaniclastic rocks intruded by plutons that range in composition from quartz diorite to diorite peridotite. In the Craig study area, the contact between the rocks of the Gravina-Nutzotin overlap assemblage and the Alexander terrane is the Clarence Strait fault and an unnamed fault on southern Cleveland Peninsula (Brew and Ford, 1984).

The Taku terrane includes layered rocks that underlie the northeastern part of the study area on Bronson Island and the Cleveland Peninsula. The terrane consists of complexly deformed and metamorphosed late Paleozoic and Mesozoic pelitic sedimentary rocks and subordinate felsic to mafic volcanic rocks intruded by intermediate and felsic plutons of Mesozoic and Cenozoic age (Siberling and others, 1982).

Regional structures in the Craig study area include northwest- and east-west-trending high-angle lateral and extensional faults, and some moderate-angle contractional faults. Regional metamorphism generally ranges from zeolite to greenschist facies, but locally reaches amphibolite facies, particularly in the southern and northeastern parts of the study area (Eberlein and others, 1983).

Geochemistry

Reconnaissance exploration geochemical studies were conducted during 1969 (Clark and others, 1970a-f, 1971) by the USGS as part of its Heavy-Metals Program, and during 1983-1985 and 1989 as part of the ongoing AMRAP studies. Three different media were sampled: (1) stream sediments, (2) heavy-mineral concentrates panned from stream sediments, and (3) rock samples. This report presents the distributions of anomalous concentrations of 17 elements in the minus-80-mesh stream-sediment samples. The geochemistry of stream sediments is generally indicative of upstream bedrock geology; it may also reveal extensive areas of exposed mineralized rock.

A total of 1,292 minus-80-mesh stream-sediment samples were collected during the 1969, 1983-1985, and 1989 field seasons. Descriptions of the geochemical sampling, sample preparation, and analytical methods used in the reconnaissance studies, as well as tabulated geochemical data, statistical data, and sample-site maps, were presented in Clark and others (1970a-g), and McDanal and others (1991).

New sampling and analytical procedures developed since the early geochemical investigations were conducted in the quadrangle dictated that the samples should be analyzed for different suites of elements. In addition, the changes in lower detection limits over the years, as analytical methods improved, presented problems in data interpretation, especially with regard to selecting geochemical thresholds for target elements.

The 17 target elements selected for this report were divided into three groups. The first group contains those elements of potential economic significance that are commonly present in concentrations that are well above the lower detection limits. These elements are Cu, Pb, Zn, and Ba. Elements in the second group are commonly associated with mineral deposits, but levels of analytical determination are so high that nearly all values suggest mineralization. These elements are Ag, Au, Hg, Cd, As, Sb, Bi, and Mo. The third group of elements is associated with known deposits of rare-earth elements and radioactive anomalies within the project area (Denny, 1962; MacKevett, 1963). These elements are La, Nb, Y, Be, and Th.

In order to distinguish geochemical anomalies from background values, a threshold value for each of the selected elements was determined. The thresholds were arbitrarily selected following the inspection of the elemental data contained in histograms and percentile tables and consideration of the following factors: (1) the average abundance of the elements determined in different lithologies (following the procedures of Levinson, 1974; and Krauskopf, 1967); (2) previously established threshold values of adjoining quadrangles (Petersburg and Port Alexander, 1:250,000-scale) that contain similar lithologies and lithotectonic terranes (Cathrall and others, 1983); (3) threshold values established by earlier studies in the Craig quadrangle (Clark and others, 1970a-f, 1971; Herreid and Rose, 1966; Herreid and Trible, 1973; Herreid and others, 1978); and (4) statistical data obtained from the National Uranium Resource Evaluation and the nationwide Hydrogeochemical and Stream Sediment Program of the U.S. Department of Energy (Los Alamos National Laboratories, 1980, 1982a-c, 1983), and the Oak Ridge Gaseous Diffusion Plant (1981a-c).

Table 1 lists the lower limits of anomalous concentrations of selected elements in the Craig study area. Anomalous concentrations are shown by vectors that radiate from sample sites (shown as small circles). The resulting vector diagrams not only show the presence of anomalous concentrations of suites of elements, but can also be used to indicate geochemical signatures of particular types of mineral deposits. Clusters of similar vectors may represent one or more potential deposits having large areal exposure.

Table 1.—Lower limits of anomalous concentrations of selected elements in minus-80-mesh stream-sediment samples, Craig study area, Alaska
[values reported in parts per million]

Element	Value	Element	Value
Copper (Cu)	100	Bismuth (Bi)	<10
Lead (Pb)	50	Mercury (Hg)	0.14
Zinc (Zn)	220	Lanthanum (La)	20
Cadmium (Cd)	0.1	Niobium (Nb)	20
Barium (Ba)	1,500	Yttrium (Y)	50
Gold (Au)	0.02	Beryllium (Be)	2
Silver (Ag)	0.5	Thorium (Th)	100
Arsenic (As)	17	Molybdenum (Mo)	5
Antimony (Sb)	2		

REFERENCES CITED

Berg, H.C., Jones, D.L., and Coney, P.J., 1978, Map showing Pre-Cenozoic tectonostratigraphic terranes of southeastern Alaska and adjacent areas: U.S. Geological Survey Open-File Report 78-1085, scale 1:1,000,000.

Berg, H.C., Jones, D.L., and Richter, D.H., 1972, Gravina-Nutzotin belt, Tectonic significance of an upper Mesozoic sedimentary and volcanic sequence in southern and southeastern Alaska, *in* Geological Survey Research 1972: U.S. Geological Survey Professional Paper 800-D, p. D1-D24.

Brew, D.A., and Ford, A.B., 1984, Tectonostratigraphic terranes in the Coast plutonic-metamorphic complex, southeastern Alaska, *in* Bartsch-Winkler, S., and Reed, K.M., eds., The United States Geological Survey in Alaska: Miscellaneous geologic research 1982: U.S. Geological Survey Circular 939, p. 90-93.

Cathrall, John B., Day, Gordon W., Hoffman, James D., and McDanal, Steven K., 1983, A listing and statistical summary of analytical results for pebbles, stream sediments, and heavy-mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-A, 279 p.

Clark, A.L., Berg, H.C., Grybeck, D.A., and Ovenshine, A.T., 1971, Reconnaissance geology and geochemistry of Forrester Island National Wildlife Refuge, Alaska: U.S. Geological Survey Open-File Report 456, 7 p., scale 1:63,360.

Clark, A.L., Berg, H.C., Grybeck, D.A., Ovenshine, A.T., and Wehr, Raymond, 1970a, Analyses of rocks and stream-sediment samples from the Craig B-3 quadrangle, Alaska: U.S. Geological Survey Open-File Report 417, 100 p., scale 1:63,360.

______1970b, Analyses of rock and stream-sediment samples from the Craig B-4 quadrangle, Alaska: U.S. Geological Survey Open-File Report 418, 98 p., scale 1:63,360.

______1970c, Analyses of rock and stream-sediment samples from the Craig B-5 quadrangle, Alaska: U.S. Geological Survey Open-File Report 419, 89 p., scale 1:63,360.

______1970d, Analyses of rock samples from the Craig B-6 quadrangle, Alaska: U.S. Geological Survey Open-File Report 420, 45 p., scale 1:63,360.

______1970e, Analyses of rock and stream-sediment samples from Craig C-5 quadrangle, Alaska: U.S. Geological Survey Open-File Report 421, 80 p., scale 1:63,360.

______1970f, Analyses of rock and stream-sediment samples from the Craig C-6 quadrangle, Alaska: U.S. Geological Survey Open-File Report 422, 81 p., scale 1:63,360.

Denny, R.L., 1962, Operations at the Ross-Adams uranium deposit, Dixon Entrance quadrangle, *in* Alaska Division of Mines and Minerals Report for the year 1962: Juneau, Alaska, p. 89-93.

Eberlein, G.D., and Churkin, Michael, Jr., 1970, Paleozoic stratigraphy in the northwest coastal area of Prince of Wales Island, southeastern Alaska: U.S. Geological Survey Bulletin 1284, 67 p.

Eberlein, G.D., Churkin, Michael, Jr., Carter, Claire, Berg, H.C., and Ovenshine, A.T., 1983, Geology of the Craig quadrangle, Alaska: U.S. Geological Survey Open-File Report 83-91, 53 p.

Gehrels, G.E., Saleeby, J.B., and Berg, H.C., 1983a, Preliminary description of the Late Silurian-Early Devonian Klakas orogeny in the southern Alexander terrane, southeastern Alaska, *in* Stevens, C.H., ed., Pre-Jurassic rocks in western North American suspect terranes: Society of Economic Paleontologists and Mineralogists 1983 Convention, Pacific Section, May 18, 1983, Sacramento, California, p. 131-141.

Gehrels, G.E., Saleeby, J.B., Berg, H.C., and Eberlein, G.D., 1983b, Basement continuity and variations in superjacent strata in the southern Alexander terrane, SE Alaska [abs.]: Geological Society of America Abstracts with Programs, v. 15, no. 5, p. 385.

Herreid, Gordon, and Rose, A.W., 1966, Geology and geochemistry of the Hollis and Twelvemile Creek area, Prince of Wales Island, southeastern Alaska: Alaska Division of Mines and Minerals Geologic Report 17, 32 p.

Herreid, Gordon, and Trible, T.C., 1973, Analyses of stream-sediment samples, Craig A-2 quadrangle and vicinity, Prince of Wales Island, southeastern Alaska: Alaska Division of Geological and Geophysical Surveys, Geochemical Report 27, 5 sheets.

Herreid, Gordon, Bundtzen, T.K., and Turner, D.L., 1978, Geology and geochemistry of the Craig A-2 quadrangle, Prince of Wales Island, southeastern Alaska: Alaska Division of Geological and Geophysical Surveys, Geologic Report 48, 49 p.

Krauskopf, K.B., 1967, Introduction to Geochemistry: McGraw-Hill, New York, N.Y., 721 p.

Levinson, A.A., 1974, Introduction to Exploration Geochemistry: Applied Publications, Calgary, Alberta, 612 p.

Los Alamos National Laboratory, 1980, Uranium hydrogeochemical and stream-sediment reconnaissance of the Dixon Entrance NTMS and Prince Rupert D-6 quadrangles, Alaska: U.S. Department of Energy, Grand Junction Office, Report GJBX 257(80), 137 p.

______1982a, Uranium hydrogeochemical and stream-sediment reconnaissance of the Port Alexander NTMS quadrangle, Alaska: U.S. Department of Energy, Grand Junction Office, Report GJBX 153(82), 54 p.

______1982b, Uranium hydrogeochemical and stream-sediment reconnaissance of the Petersburg NTMS quadrangle, Alaska: U.S. Department of Energy, Grand Junction Office, Report GJBX 163(82), 73 p.

______1982c, Uranium hydrogeochemical and stream-sediment reconnaissance of the Craig NTMS quadrangle, Alaska: U.S. Department of Energy, Grand Junction Office, Report GJBX 187(82), 34 p.

______1983, The geochemical atlas of Alaska, compiled by the geochemist group, project leader T.A. Weaver: Los Alamos National Laboratories, Los Alamos, New Mexico, GJBX 32(83), 57 p.

MacKevett, E.M., Jr., 1963, Geology and ore deposits of the Bokan Mountain uranium-thorium area, southeastern Alaska: U.S. Geological Survey Bulletin 1154, 125 p.

McDanal, S.K., Arbogast, B.F., and Cathrall, J.B., 1991, Analytical results and sample locality map of stream sediment, heavy-mineral concentrate, pebble, and rock samples from the Craig project area—Craig, Dixon Entrance, Ketchikan, and Prince Rupert quadrangles, Alaska: U.S. Geological Survey Open-File Report 91-36A-B, 124 p., 2 plates, scale 1:250,000.

Monger, J.W.H., and Berg, W.C., 1987, Lithotectonic terrane map of western Canada and southeastern Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1874-B, 21 p., scale 1:2,500,000.

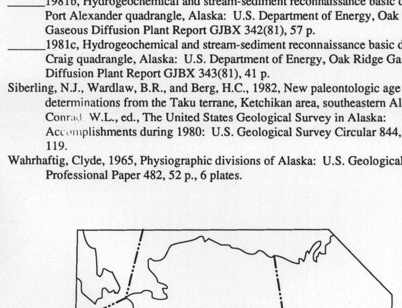
Oak Ridge Gaseous Diffusion Plant, 1981a, Hydrogeochemical and stream-sediment reconnaissance basic data for Petersburg quadrangle, Alaska: U.S. Department of Energy, Oak Ridge Gaseous Diffusion Plant Report GJBX 278(81), 55 p.

______1981b, Hydrogeochemical and stream-sediment reconnaissance basic data for Port Alexander quadrangle, Alaska: U.S. Department of Energy, Oak Ridge Gaseous Diffusion Plant Report GJBX 342(81), 57 p.

______1981c, Hydrogeochemical and stream-sediment reconnaissance basic data for Craig quadrangle, Alaska: U.S. Department of Energy, Oak Ridge Gaseous Diffusion Plant Report GJBX 343(81), 41 p.

Siberling, N.J., Wardlaw, B.R., and Berg, H.C., 1982, New paleontologic age determinations from the Taku terrane, Ketchikan area, southeastern Alaska, *in* Conrad, W.L., ed., The United States Geological Survey in Alaska: Accomplishments during 1980: U.S. Geological Survey Circular 844, p. 117-119.

Wahrhaftig, Clyde, 1965, Physiographic divisions of Alaska: U.S. Geological Survey Professional Paper 482, 52 p., 6 plates.



INDEX MAP SHOWING LOCATION OF CRAIG, DIXON ENTRANCE, AND THE WESTERN EDGES OF THE KETCHIKAN AND PRINCE RUPERT QUADRANGLES

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INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1993

GEOCHEMICAL MAPS SHOWING THE DISTRIBUTION OF SELECTED ELEMENTS IN STREAM-SEDIMENT SAMPLES FROM THE CRAIG, DIXON ENTRANCE, AND WESTERN EDGES OF THE KETCHIKAN AND PRINCE RUPERT QUADRANGLES, SOUTHEAST ALASKA

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